

## SECTION A – PLANNING AND DESIGN

## A-1 ENVIRONMENTAL SITE DESIGN (ESD)

The Stormwater Management Act of 2007 (Act) requires that the Code of Maryland Regulations (COMAR) be modified and a model ordinance developed for the purpose of implementing environmental site design (ESD) to the maximum extent practicable (MEP). Significant changes to COMAR and the 2000 Maryland Stormwater Design Manual, Volumes I & II (Design Manual), were adopted in May 2009. These changes specify how ESD is to be implemented, how the MEP standard is to be met, and how the review of erosion and sediment control and stormwater management plans is to be integrated.

The Act defines ESD as "using small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources." ESD also emphasizes conserving natural features, drainage patterns, and vegetation; minimizing impervious surfaces; slowing down runoff; and increasing infiltration. This definition, the modifications to COMAR, and the procedures and practices presented herein will guide developers and designers submitting plans for approval. The changes required to implement the Act are significant and will compel consideration of runoff control from the start of the land development process. As a result, erosion and sediment control and stormwater management for new development and redevelopment will be conceived, designed, reviewed, and built differently than prior to passage of the Act.

## A-2 DESIGN AND REVIEW PROCESS

The Act requires the establishment of a comprehensive process for the review and approval of sediment control, and stormwater management plans. Planning for erosion and sediment control needs to start early and be integrated with stormwater management practices. Additionally, acceptable plans must be designed to prevent soil erosion from developing, prevent increases in stormwater runoff, and minimize pollutants in nonpoint discharges. A coordinated, comprehensive review process includes the submittal and review of erosion and sediment control and stormwater management plans for each of the following three phases of plan development:

### 1. CONCEPT PLAN

### 2. SITE DEVELOPMENT PLAN

### 3. FINAL PLAN

This process is outlined and described in more detail in Figure A.1.

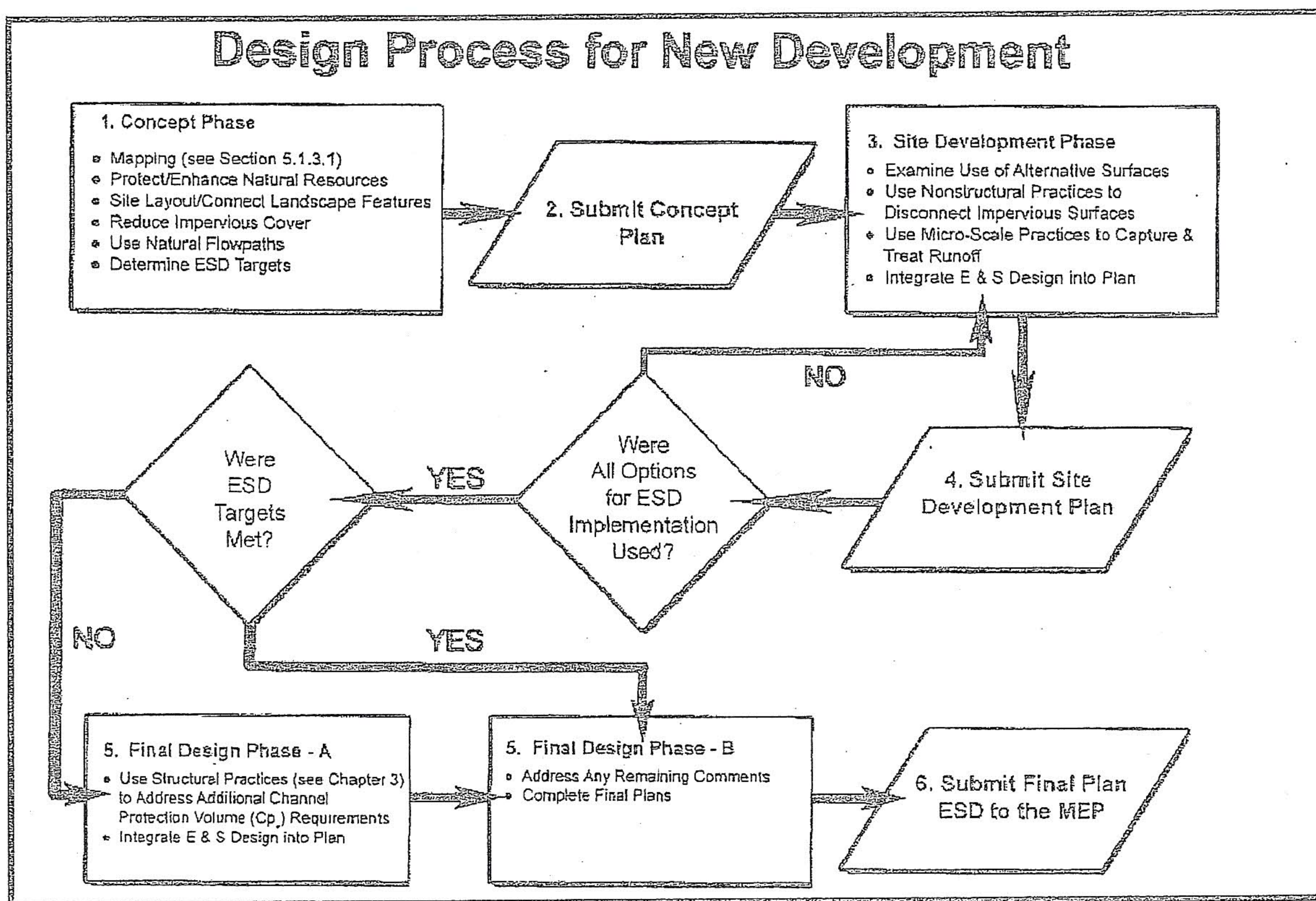


Figure A.1: Design Process for New Development  
(Source: New Chapter 5 of 2000 Stormwater Design Manual)

### Concept Plan

Developing a site plan begins with gathering, mapping, and analyzing information about the physical characteristics of the site. Designers should visit the proposed development site in order to clearly understand its topographic, vegetative, drainage and soil characteristics. Relying exclusively on topographic maps, soils maps, and other materials found in the office without field verification is not an acceptable planning technique.

The topography of the site, mapped at suitable contour intervals, will allow the identification of drainage patterns, slopes, and natural resources such as wetlands, seeps, streams, forests, critical areas, and buffers. Mapping the flow of water onto, through, and off the site enables the delineation of drainage areas and flow patterns. Downstream wetlands, lakes, streams, structures, or other areas particularly sensitive to damage from erosion and sedimentation should also be investigated, mapped, and incorporated into the design to afford these areas additional protection. The design should never allow sediment to flow through a sensitive area.

Investigating the site soil characteristics by geotechnical testing and referring to local soil surveys enables the designer to identify highly erodible soil areas that if possible should remain undisturbed. Long or steep slopes (**steeper than 15%**), highly erodible soils, and vegetative buffer strips along water bodies should be mapped and designated to remain undisturbed.

As plans are developed using ESD per the new Chapter 5 of the *Maryland Stormwater Design Manual*, the concept plan at a minimum requires a narrative describing how erosion and sediment control will be integrated into the stormwater management strategy.

#### **Site Development Plan**

After concept plan approval, the designer should use comments, suggestions, and feedback received during the concept phase in preparing site development plans. The site development plan will establish the footprint of the proposed project and demonstrate the relationship between proposed impervious surface and the existing natural conditions identified during concept plan design. This will better protect natural resources and buffers and allow for using ESD practices throughout the site. Included in this step are the preparation of detailed designs, computations, and grading plans for a second comprehensive review and approval. After approval from the review agencies, the applicant will then proceed with final plan preparation including the design of any structural practices needed to address remaining channel protection requirements. Final plans will go to both the stormwater and erosion and sediment control review agencies for approval.

An overlay plan showing stormwater and erosion and sediment control practices are required as part of the site development submittal.

#### **Final Plan**

Comments from the site development plan approval should be incorporate into developing final phase design plans. Existing site topography as well as proposed contours must be shown at the appropriate interval for the limit of disturbance (LOD), including contours for sediment controls such as sediment traps and sediment basins. Final erosion and sediment control plans should include the location of each sediment control practice and associated construction notes. Details and representative cross-sections, as appropriate, should also be included on the final plans. Drainage areas must be delineated for sediment control practices whose sizing is based on drainage area. These should include not only proposed, but initial phase and interim phase practices and drainage areas. The sequence of construction and associated narrative must be detailed enough to guide the contractor through the process of construction, maintenance, and removal of the erosion and sediment controls.

### A-3 DESIGN PRINCIPLES

This section offers design strategies and planning guidance. The principles listed in Table A.1 should be followed in developing erosion and sediment control plans that protect against downstream erosion, capture sediment on-site, and meet all applicable guidelines and requirements.

Table A.1: Principles of Land Development

Design Principles
Plan the development to fit the site
Minimize disturbed areas - duration (phasing) and extent (limits of disturbance)
Protect and avoid natural resources
Protect and avoid steep slopes and highly erodible soils - note looks @ 25% or greater slopes
Stabilize exposed soils as soon as practicable
Control and/or manage on-site and off-site runoff
Use perimeter controls
Retain sediment on-site through settling, dewatering, and filtering
Inspect and maintain sediment controls

#### Plan the development to fit the site

A primary goal of ESD is the conservation of natural features (e.g. drainage patterns, soil, vegetation) to the maximum extent practicable. Working with a site's natural features when designing improvements minimizes the amount of necessary clearing and grading. Using the existing contours as much as possible reduces cuts and fills. Roads should be designed parallel to the contours rather than perpendicular to them. In this way, steep slopes are minimized and the earthwork can be kept to a minimum. Developing flatter slopes decreases the area that needs to be cleared compared to development in steeper terrain. Fitting the development to the site results in less erosion and saves costs by limiting the amount of cut and fill as well as the need for structural components such as retaining walls.

#### Minimize disturbance - duration and extent

When soil disturbances occur and the natural vegetation is removed, the potential for erosion increases thereby requiring more sediment controls to keep sediment on-site. To reduce the need for sediment controls, the extent and duration of soil exposure should be minimized. This is best achieved by phasing and sequencing. When a project is phased the active work area is limited to a portion of the site. A well designed plan will include phases or stages of development that ensure only areas under active development are exposed. All other areas should have a good cover of vegetation or mulch. Also, grading should be completed and stabilized as soon as possible after it is initiated.

in only  
disturb  
20 acres  
@ a  
time

The project should be phased such that no more than one grading unit of land is disturbed at a time. A grading unit is a contiguous area of disturbed earth on a site at any given time and is limited to 20 acres, or as determined by the appropriate approval authority. Unless otherwise specified or approved, clearing and grubbing shall be limited to a single grading unit. Work may proceed to a second grading unit only when the fifty percent of the first grading unit has been stabilized and approved by the appropriate enforcement authority.

The sequencing of activities also enables the project to be completed in an efficient way that balances earth work. For example, a proposed roadway with large sections of cut and fill should be sequenced so that the areas in cut are graded first, followed by the areas in fill. A detailed sequence of construction will coordinate the timing of grading and construction activities with the installation of erosion and sediment control measures.

#### **Protect and avoid natural resources**

Special attention should be paid to disturbed areas adjacent to natural resources, steep slopes, and erodible soils. A site's natural resource areas, such as wetlands, springheads, floodplains and stream buffers, are to be mapped during the concept plan stage.

The approach for protection of natural resources is as follows:

- **AVOIDANCE**
- **MINIMIZATION**
- **MITIGATION**

Impacts to natural resources should be avoided as much as practicable. If avoidance is not feasible, every effort should be made to minimize impacts. Permanent impacts to resources require mitigation, often at a 2:1 or more replacement rate or in the form of compensation. Construction of erosion and sediment controls resulting in temporary impacts to resources may require re-establishing or creating vegetative buffers within the project limits or enhancing existing resources outside the project limits.

If a project has a direct discharge into a Tier II water body or an impaired water body with a Total Maximum Daily Load (TMDL) for sediment, an additional level of control(s) may be needed. This includes but is not limited to accelerated stabilization, passive or active chemical treatment systems (see Figure A.2.), redundant sediment controls, or a reduction in the size of the grading unit.

#### **Protect and avoid steep slopes and highly erodible soils**

Protection of steep slopes is imperative to reducing erosion, and therefore these areas should be identified in the concept plan. Slopes steeper than 15% shall be avoided to the maximum extent practicable. If steep slopes must be developed, protection strategies include accelerated vegetative stabilization, structural stabilization, (e.g., mechanically stabilized slopes), diverting runoff around or over (e.g., pipe slope drains) steep slopes, benching, and incremental stabilization. Other stabilization methods include soil stabilization matting and turf reinforcement mats.

Soil erodibility is a measure of a soil's resistance to the erosive powers of rainfall energy and runoff. Highly erodible soils have less resistance to erosion. Additionally, soils with fine silts and clay particles, once eroded, remain suspended for an extended time period. Turbidity control measures, as outlined in Figure A.2, are required when disturbing soils with high clay content. Information regarding highly erodible soils is provided in the Appendix.

NOTE

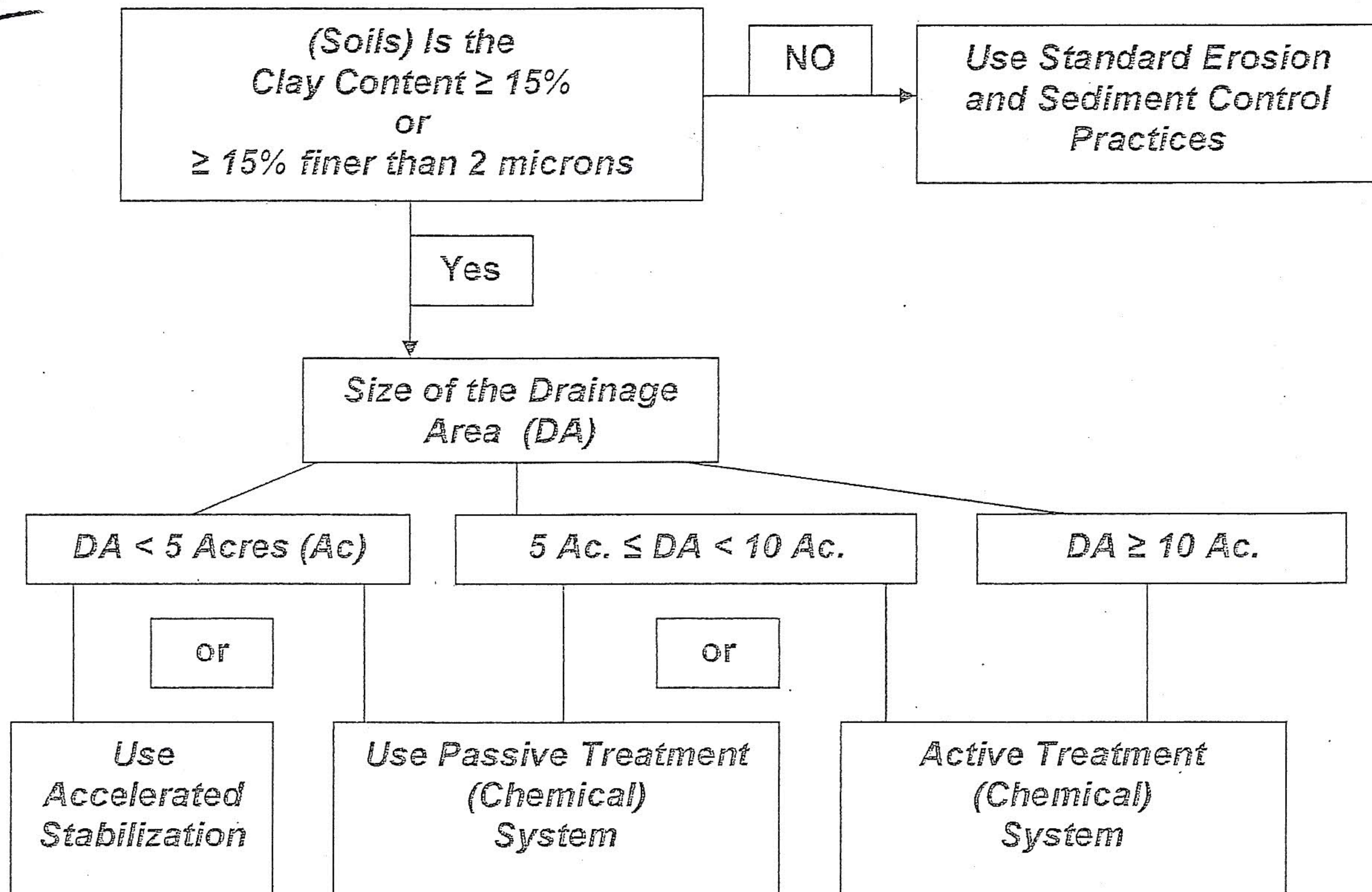


Figure A.2: Turbidity Control System (TCS) Flow Chart

**Stabilize exposed soils as soon as practicable**

Minimizing disturbed areas, both in size and duration, is critical for preventing erosion and sediment runoff. Areas that must be disturbed should be stabilized as soon as possible. At a minimum, permanent or temporary stabilization is to occur within three calendar days following soil disturbance on all perimeter controls (e.g., earth berms, sediment traps) and slopes greater than 3:1 and seven days for all other disturbed areas. Only areas under active grading, or on certain sites such as surface mines, are exempt from these requirements. Accelerated stabilization may be required based on site characteristics or at the request of the appropriate approval authority.

See Section B-4 for specifics on stabilization, including types of seeding, timeframes, and alternative stabilization methods. All stabilization requirements should be included on the erosion and sediment control plan.

**Control and/or manage runoff**

Flows onto, through, and off of the site must be evaluated. Consideration should be given to the type of flow (sheet versus concentrated) and the slope, land use, and size of the contributory drainage area. Peak discharges and velocities, as well as the volume of flow through and discharging from the site, need to be controlled to minimize soil erosion.

Most sediment controls are sized for the drainage area discharging to the control. This includes off-site as well as on-site runoff, from undisturbed as well as disturbed areas. Reducing the drainage area may allow the use of a simpler, alternative practice (e.g. a sediment trap instead of a sediment basin).

Typically water conveyances (see Section C) are used to divert runoff around the project site. These include earth dikes, temporary swales, perimeter dike swales, diversion pipes, and permanent ditches which are often constructed early in the project. On-site runoff volumes and velocities can be controlled with erosion control devices such as check dams, pipe slope drains, outlet protection and other similar measures, as well as by establishing vegetation promptly and maintaining it vigilantly.

#### Use perimeter controls

The main objective of a sediment control plan is to prevent sediment laden water from leaving the project site. Generally, this is achieved by installing sediment control practices along the perimeter of the disturbed area. Although perimeter controls tend to be linear in nature, sediment traps and basins can also be perimeter controls. Earth dikes, temporary swales, diversion fence, berms, silt fence, and super silt fence are other examples of perimeter controls. Sediment controls designed along the perimeter of a site typically need to be installed before clearing and grading operations begin. Prior to installing perimeter controls, the limits of disturbance (LOD) should be clearly marked in the field. This will help to ensure that no construction takes place outside the approved limits of disturbance.

#### Retain sediment on-site through trapping, filtering, and/or dewatering

Sediment can be retained by either trapping or filtering or a combination. Practices such as sediment traps and basins impound sediment-laden runoff for a period of time sufficient for soil particles to settle out. Filtering practices include silt fence, temporary outlet structures, and inlet protection. When a sump or trapping area needs to be drained, the sediment laden water is pumped through a dewatering device, such as a portable sediment tank or a filter bag, where the sediment is separated from the effluent and retained for disposal.

Perimeter controls are the last line of defense on a construction site. These controls must be installed prior to any clearing and grubbing for the remainder of the project and they must be stabilized as soon as possible after they are constructed, preferably within 24 hours, but no more than 3 days after their construction. The designer should use a combination of controls to convey runoff non-erosively, divert clear water flow around the construction site, and to intercept and treat sediment-laden water through the appropriate sediment control.

#### Inspect and maintain sediment controls

Proper implementation of the erosion and sediment control plan is as important as good planning and design. Erosion and sediment controls are ineffective without proper installation and maintenance. Thorough, periodic maintenance checks of erosion and sediment control measures are necessary to ensure proper operation. Although enforcement is beyond the control of the designer and reviewer, the plans and specifications need to be clear and concise so they can serve as an effective enforcement tool. Inspection requirements should be provided on the plans and depending on the approval authority may be stated in the approval or permit. The owner/developer and contractor are responsible for conducting routine inspections and required maintenance. At a minimum, the site and all controls should be inspected weekly and after each rain event. However, the approval authority may require more frequent inspections, especially adjacent to sensitive areas or in impaired watersheds. Inspections may be required on a weekly or even daily basis or prior to or during a precipitation event. A written inspection report should be part of every inspection. The inspection report should include:

- Inspection date
- Type of inspection (regular, pre-storm event, post-storm event, inspection during rain event)
- Name and title of inspector
- Weather information (current conditions as well as time and amount of last recorded precipitation)
- Brief description of project's status (e.g., percent complete) and/or current activities
- Evidence of sediment discharges
- Identification of sediment controls that require maintenance
- Identification of missing or improperly installed sediment controls

- Compliance status regarding the sequence of construction and stabilization requirements
- Photographs
- Maintenance performed
- Installation or re-installation of sediment controls

The appropriate enforcement authority should be notified and the following meetings/inspections of the site should be requested:

1. Pre-construction meeting;
2. After installation of sediment controls for each phase; and
3. After stabilization and prior to removal of the final-phase sediment controls.

Implementation of the approved erosion and sediment control plan is required. The appropriate approval authority must be consulted of any desired modifications to the approved plan. Modifications may be implemented only upon written approval from the approving authority or in accordance with an MDE-approved minor field modification policy.